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ABSTRACT

After a brief discussion of when a school board should consider modernizing mechanical and electrical equipment the speaker explored the specifics of lighting, heating, and ventilation. Technical data on foot candles, types of light fixtures, and the importance of air conditioning in modern school buildings are presented. The presentation concludes with the recognition of the need for research on air conditioning in existing buildings. (GM)

[redacted]

When and What to Modernize

by D. Dana Price*

MODERNIZATION SHOULD BE UNDERTAKEN ONLY AFTER THE FEASIBILITY OF THE PROJECT HAS BEEN STUDIED BY A COMPETENT ARCHITECT AND ENGINEER

Modernization of the mechanical and electrical equipment of a school plant is usually considered when:

1. Money is not available for a new building and it is thought that for a small amount of money the old building can be made like new.

2. Some part of the system breaks down completely.

3. New buildings are being planned on the same site.

In the case where money is not available for a new building and an attempt is being made to modernize a building over twenty five years old, a competent architect and engineer should be commissioned to study what can be done, what the cost will be, and to advise whether or not it is feasible. Sometimes it is better to pay a competent professional to make a feasibility study and to be advised if you would be wasting your money rather than blindly start issuing contracts to several independent contractors. In most cases large expenditures on very old buildings cannot be justified. It would be better to organize a Citizens' Committee and plan a modern school which would show less owning and operating cost over a twenty year period.

Now consider the time when some part of the system has broken down completely. This certainly is not the ideal time to make a decision on a major modernization of the mechanical and electrical system in a building.

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DOCUMENT RESUME

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ABSTRACT

This publication presents procedures for estimating future pupil yield from new housing developments which make possible good administrative decisions as to the location and design of school buildings. The growth of suburban metropolitan areas surrounding populous urban areas in the past several decades contributes to complex school building problems. The lack of adequate planning by suburban school officials has frequently caused school children to be housed in substandard school environments. Reasonably accurate predictions of future school enrollment prevent overcrowding crises and tax revenue wastes. This Baltimore study considers the variables of location, type, number of bedrooms, number of children, living in assessed valuation or rental costs of dwelling units. The study concluded that pupil yield varies by geographic area, type of dwelling unit, number of bedrooms per unit, value of dwelling unit, and the size of the lot on which the housing unit was constructed. The method developed by this study for predicting future pupil enrollments has applicability for other large emerging suburban school systems. (JZ)

Predicting Pupil Yield

BY TYPES OF DWELLING UNITS

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Among many other persons who should be mentioned, including the elementary school teachers and principals in the public schools of Baltimore County, the authors express their sincere and deep appreciation to: the Board of Education of Baltimore County; the many superintendents who responded to inquiries; the volunteer helpers who assisted in gathering the basic data; the citizens of Baltimore County for their indulgence and cooperation; and the many prominent educators who rendered invaluable aid in planning the basic study.

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Although the authors assume full responsibility for the content of this study, they gratefully acknowledge the valuable assistance received.

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Predicting Pupil Yield by Types of Dwelling Units

PREFACE

Efficient schoolhouse planning has long been recognized as one of the most important problems in the field of public education. School buildings are relatively permanent structures, consequently it is important that they be located properly, designed to meet the needs of the people, and, when necessary, be capable of inexpensive modification to meet the needs of future educational programs.

In a school district as large as Baltimore County, comprising approximately 607 square miles, it is imperative that school officials determine those areas within the county that are likely to experience the most rapid pupil growth. School authorities would be greatly assisted in this endeavor if they possessed a tool which would predict accurately the number of children that would emanate from new housing developments prior to the time the families actually occupy the dwelling units.

It is the purpose of this study to: (1) develop a technique for estimating pupil yield by types of dwelling units which would be applicable in many metropolitan school districts and (2) derive specific pupil yield figures by types of dwelling units for Baltimore County, Maryland.

Approximately 1,600 teachers and a similar number of voluntary adult helpers conducted a door-to-door census

to secure the data needed for this study. The data secured for each dwelling unit in Baltimore County consisted of: (1) type of dwelling unit; (2) its location by local election district and elementary school attendance area; (3) the number of bedrooms it contains; (4) its assessed value; (5) the width of the lot on which it is located; and (6) the number of pre-school, elementary, junior high, and senior high school children occupying the units. These data were recorded on a printed checklist to standardize the interview and the responses. Complete information was solicited from 109,006 dwelling units.

The data were transferred to Remington Rand punched cards and then sorted by election district, type of dwelling unit, number of bedrooms per dwelling unit, assessed valuation, and number of pupils. On the basis of these data, ninety basic tables were prepared depicting existing pupil yield (15 election districts x 6 types of dwelling units). From these ninety tables composite or summary tables were prepared and the data submitted to a double entry analysis of variance design in an attempt to identify significant and consistent trends between and within the data.

For every type of dwelling unit tested there were highly significant differences between the yields for levels of school, that is, pre-school, elementary, junior

high, and senior high. Generally speaking, the pupil yield per dwelling unit at each level of school tends to increase directly with an increase in the number of bedrooms; likewise, the number of older children, junior high and senior high school, tends to increase directly with an increase in the number of bedrooms.

In many instances the election district wherein the dwelling unit is located appears to be a deciding factor governing pupil yield. In some localities there appears to be a reasonably high correlation between the assessed value of the dwelling unit and pupil yield, and between the width of the lot on which the dwelling unit is located and pupil yield.

No part of this study is intended to replace sensible human judgment in predicting future pupil yield. However, the material presented herein is expected to provide a reliable tool in an area where few such tools exist. It is strongly felt that the technique presented in this study, coupled with additional knowledge concerning the dwelling habits in Baltimore County should constitute a reliable basis upon which sound predictions of future pupil yield can be made.

Predicting Pupil Yield
By
Types of Dwelling Units

Introduction

Baltimore County is one of the largest and most populous counties in the State of Maryland. Shaped like a large horseshoe, the county practically surrounds the City of Baltimore. It is unique in that there are no incorporated towns or cities within its limits. It is governed by an executive officer and an elected council of seven members serving four-year terms.

A continuous process of growth has gone on in Baltimore County since its inception in 1659. The progress made in each succeeding era has been progressively greater than that of the preceding and each generation of Baltimore Countians has felt the influence of a mingling of old and new as the changed order has emerged.

When the first Federal Census was taken in 1790, nearly 39,000 people lived in Baltimore County. In the 100-year interval between 1850 and 1950, the population in the county reached 270,000. Between 1950 and 1954 the number of people living within its boundaries increased by 42% and by 1957 the estimated population was approximately 400,000 and expected to reach the one-half million mark by the year 1960. This unprecedented increase in population and the causes back of it have brought about marked changes in Baltimore County and have meant a long period

of continuous but rapid transition. Because of this rapid transition the schools have had to adjust to great social, economic, and scientific changes. They have been compelled to adjust and readjust to local problems which demand immediate attention.

The most serious problem currently confronting school officials is the overwhelming increase in the number of school age boys and girls now living in the county. In some years the school population has increased at a more rapid rate than the county population. In 1950 more than 40,000 pupils were enrolled in the public schools. By 1957 that figure had jumped to 73,000. By 1963 it is estimated that over 100,000 students will attend the public schools of Baltimore County. This gain in school population has made it necessary for the Board of Education to plan school sites and buildings well in advance of the actual need. Since 1946, Baltimore County has provided almost 2,000 new classrooms with a pupil capacity of over 63,000. An additional 226 classrooms were under construction in 1959. Yet, in spite of this massive construction program, the Superintendent of Schools has publicly stated that existing classroom shortages based on <u>currently available funds</u> and the estimated shortages based on enrollment projects will leave Baltimore County with a deficit of over 500 classrooms by 1962.

In a rapidly developing metropolitan and rural fringe area such as Baltimore County, growth and conse-

quent school building needs are not uniformly distributed throughout the area. The careful planning of each specific school building project becomes increasingly important as the individual local areas reach population saturation, develop irregularly as a result of economic influences, or begin to develop as the total population grows. Planning the location, size, and the timing of school building construction depends upon the accurate projection of school enrollment on a local basis.

Whether or not local projections are reliable guides for planning school building projects depends largely upon the accuracy and completeness of the basic information used and the extent to which such data is localized. The advantages of predicting school enrollment and attempting to project enrollments in a specific area as a means of planning school building construction are manifold, yet objective determination is a complex undertaking.

It would seem, however, that in an area as large and diverse as Baltimore County where the financial apportionment for school building construction of necessity amounts to many millions of dollars annually, a thorough approach to this problem is justified. The development of a technique to enable both school officials and local planning authorities to predict future enrollments with accuracy would be most helpful in planning the optimum use of existing facilities and in determining the extent, size,

and relative location for such additional facilities as are or may be needed.

Review of the Literature

Predicting school population is a highly speculative endeavor. Nevertheless, the need and requests for population projections are increasing. As a result, a variety of techniques and methods have been and are being developed. Many of the procedures attempt to analyze separately a factor which influences population change and to evaluate and assess its probable effect on future population in a given area. Other techniques are more mechanical in nature and in numerous instances can be described by mathematical formulas or curves.

The techniques most commonly in use fall generally into about three categories; "mathematical" methods which make use of past trends in total population of the area; demographic techniques analyzing separately the trends in the components of population change (births, deaths, migration); and a variety of miscellaneous techniques using symptomatic data to estimate future total population without intermediate estimation of components.

In the first category, mathematical, a variety of techniques and methods exist ranging from linear extrapolation of past trends to the more complex logistic curve. A most notable advantage of this particular kind of procedure is its relative simplicity. Also, mathematical techniques usually require considerably fewer data than other techni-

ques. There is a justifiable rationale to mathematical methods over a short span of time since a high correlation exists between population changes in successive periods. A notable weakness in this technique, however, is that it hardly can allow for anticipated deviations from past trends and is usually best suited for forecasting total population.

The second category, the component method, seems to be growing in favor. The component procedures are more logical in conception than mathematical methods and enable the forecaster to confine the area of speculation to the appropriate components. Furthermore, this technique is sufficiently flexible to enable the forecaster readily to incorporate anticipated local developments that may affect the future trends in the components.

Most of the prediction methods described in the literature for the past decade or two use the entire school district as a unit. Although valuable for some purposes, data of this type are of limited usefulness in planning a school building program where the district is large and the existing buildings are many. To date, no exact methods or formulae have been developed which can predict future changes in population in local areas with any high degree of accuracy.

Statement of the Problem

In a school district as large as Baltimore County, it is imperative that school officials determine those

areas within the county that are currently experiencing and are likely to experience the most rapid growth. School authorities would be greatly assisted in this endeavor if they could predict accurately the number of children that would likely attend school from any new housing development prior to the time that families actually occupy those dwelling units.

More than five hundred superintendents and numerous researchers have expressed a desire for this study to be attempted. They have expressed the belief that knowledge of such a relationship would be extremely valuable in predicting school enrollments, planning school building programs, and preparing needed curriculums.

Specifically, an extensive and intensive study of 109,006 dwelling units was undertaken in Baltimore County to determine the relationship between types of housing and selected characteristics of family size. An established relationship would conceivably permit the construction of a tool adequate to predict, on the basis of selected factors, the number of children that would attend a public elementary, junior high, or senior high school from a new housing development.

Underlying the investigation undertaken are the following axiomatic assumptions: (1) housing developments will continue to be erected in Baltimore County; (2) enrollment in the schools of Baltimore County will continue to increase; (3) Baltimore County will continue to build

school buildings; (4) there is a continuous need for educators to predict accurately the school enrollment; (5) it is desirable to erect school buildings as soon as possible to house adequately the school population; and (6) great financial savings will accrue if school buildings are efficiently located and are of desirable size.

Definitions

For the purpose of this study, all dwelling units in Baltimore County have been classified into six major categories. Thus, what actually is a wide variety of units is reduced to a manageable number of classifications. The expressions used to identify the several types of dwelling units are meant to be self-explanatory. However, to avoid possible misunderstanding the following definitions apply: (1) A single dwelling unit is defined as a group of rooms specifically designed to accommodate one family; (2) an apartment is defined as a room or group of rooms specifically designed as living quarters and usually rented on a monthly basis; (3) a row house is defined as one of three or more dwelling units abutting one another; (4) a semi-detached unit is defined as one of two units each containing a group of rooms designed as living quarters abutting one another, that is, sharing a common wall; (5) a farm dwelling is defined as a group of rooms designed as living quarters located in rural areas and typically housing a family whose major income comes from agriculture or related pursuits; and (6) a trailer is defined as a

mobile unit specifically designed as living quarters.

Other terms employed in the study are defined as follows: (1) A household is defined as the entire group of persons who occupy a house, apartment, or other type of living quarters classified as a dwelling unit; (2) a dwelling unit is defined as a group of rooms or a single room utilized as separate living quarters by a family or group of persons living together or by a person living alone; and (3) an election district is defined as a clearly defined geographical area established for the purpose of voting by areas (Baltimore County's 607 square miles have been sub-divided into 15 political election districts); (4) pupil yield per dwelling unit is defined as the total number of persons residing in a given dwelling unit from birth through age seventeen and including those youngsters over age seventeen but who are currently attending private or public secondary schools.

Methodology

Until 1956, Maryland State Law specifically required each local board of education to conduct a biennial school census. The law has since been changed and now permits, but does not require, each local board of education to conduct a biennial school census. Since Baltimore County has continued to conduct such a census it was felt that this was the logical time to gather the basic information necessary for a study of pupil yield. After extensive reading, numerous discussions, and many conferences, a

detailed plan of operation evolved. Nearly 500 superintendents were contacted to determine if, in their opinion, the study would be of potential value to them. Positive responses were received from 402 persons. In those school districts experiencing considerable growth, the superintendents overwhelmingly indicated their desire for such a study to be conducted. The study was then discussed with the Baltimore County Superintendent of Schools, his staff, and the Board of Education. Following clearance at this point the materials needed to conduct the study were formulated, cleared, and printed and/or mimeographed in sufficient quantity.[1]

On September 17, 1958, the detailed plan of operation that evolved was explained to all elementary school principals in Baltimore County. After being thoroughly briefed, the principals in turn explained the procedure to be followed to their respective faculties.

Very briefly, the census was taken on the afternoons of October 8, 9, and 10. All elementary schools were closed at 12:15 on these days. Afternoon sessions met as usual with the teachers of afternoon sessions completing census work in the mornings. All children through age seventeen were enumerated. In order to complete the work in the three afternoons allotted it seemed advisable for each school to enlist the aid of their PTA members to work as census enumerators or in other capacities. This brought

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[1]See Appendix for samples of these materials.

the total number of enumerators to approximately 3,200, that is, 1,600 teachers and 1,600 adult, volunteer, non-paid helpers. The data for each dwelling unit were secured from the head of the household and were recorded by the enumerator on printed cards as a precaution to standardize the interview and the responses. A duplicate of the census card used to secure the data for this study is depicted on the next page. Part I of the census card (top half) contained the usual census data and Part II (bottom half) contained the form for soliciting the particular information needed to develop pupil yield indices. The reader can readily see that this portion of the census card contains seven basic questions. It was necessary, however, for enumerators to ask each resident not more than four questions. Questions 1 and 7 were completed in the school before the cards were distributed. Question 6 related only to apartments while Question 5 was completed for all other types of units. The enumerators had but to ascertain the lot width (when this applied), number of bedrooms, number of children at each level of school, and assessed value or rental figure.

Part II of the census card is arranged to facilitate the recording of data on punched cards. The data recorded on the bottom half of each card was recorded on a single Remington Rand punched card. Since there were 109,006 usable census cards returned by enumerators, a correspond-

Form to be Completed for EACH DWELLING UNIT in County
Baltimore County Public Schools
Census and Pupil Yield

W ___ C ___
Check one

Parent or Guardian _____
Last Name First Middle

Address _____
No. Street or Road City or Town

Telephone Number _____

School Preparing Card

DATA ON EACH CHILD (Through age 17) Last Name First M.I.	Date of Birth Day	Mo.	Year	Age Dec.31 1958	Sex B	G	In School Pub.	Non-Pub.	Grade	Not * in School	Handicapped
1.											
2.											
3.											
4.											
5.											

*If child is of compulsory school age and is not in school, please explain.

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1. Location of dwelling unit by election district (circle one):
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

2. Type of dwelling unit (check one):
1.0 __ Apartment 2.0 __ Farm dwelling 3.0 __ Trailer

4. Single dwelling
41. __ 54' or less lot width
2. __ 55' - 59'
3. __ 60' - 99'
4. __ 100' - 149'
5. __ 150' or more

5. Row house
51. __ 16' wide or less
2. __ 17' - 18' wide
3. __ 19' - 20' wide
4. __ 21' or more

6. Semi-detached
61. __ 16' wide or less
2. __ 17' - 18' wide
3. __ 19' - 20' wide
4. __ 21' or more

3. Number of bedrooms in dwelling unit (check one):

1 ___ 2 ___ 3 ___ 4 ___ 5 or more ___

4. Number of children residing in dwelling unit (insert number):
1. Pre-school 2. Elementary 3. Junior High 4. Senior high
_____ _____ _____ _____

5. Assessed valuation of dwelling unit, except apartments, computed at 60% of market value (check one):
1. __ Less than $2000
2. __ $2000-$4999
3. __ $5000-$7999
4. __ $8000-$10999
5. __ $11000-$13999
6. __ $14000-$16999
7. __ $17000-$19999
8. __ $20000-$22999
9. __ $23000 or more

6. Monthly rental for apartments (check one):
1. __ $34 or less
2. __ $35-$49
3. __ $50-$64
4. __ $65-$79
5. __ $80-$94
6. __ $95-$109
7. __ $110-$124
8. __ $125-$139
9. __ $140 or more

7. School preparing card (use number assigned to your school): _____

ing 109,006 Remington Rand cards were punched containing complete data on this number of dwelling units.

Since Part II of the census card contained information not covered by State Law, it was voluntary on the part of the occupant. Each enumerator was requested to inform the occupants that they were not required to supply the information requested in Part II but that it was believed that the information was extremely valuable and necessary for adequate school building planning. The occupant or resident was urged to cooperate in this undertaking. If the resident refused to supply the data needed, the enumerator was requested to make the necessary estimates. This was accomplished by comparing the dwelling unit in question with similar types in the same area to estimate its assessed value and by soliciting other information such as the number of children from neighbors.

If the resident or occupant of the dwelling unit was not at home at the time of the original visitation, the enumerator was requested to make one return call. If the occupant could not be reached at the time of the second call, the enumerator solicited the needed data from a neighbor, estimating when necessary.

Usually the total number of children reported on Part II of the census card agreed with the number of children listed on the top half (Part I). There was, however, the following exception: senior high school pupils and possibly junior high school pupils who were

eighteen years of age or over were not listed on the top half of the card. They were, however, counted in Question 4 on the bottom half of the card.

The assessed valuation of house trailers was computed at 60% of its current market or sale value. Also, in determining the number of bedrooms contained within a house trailer, the living room or other room intended to be converted into a bedroom during the evening hours was counted as a bedroom.

Since Part II of the census card was detachable, the resident's name and/or address did not appear. Each resident was informed that the data would be treated in a confidential manner.

Through this technique, data were secured for more than 90% of all dwelling units in Baltimore County. All data were returned to the researchers, carefully checked to see that each item was complete, and then placed on Remington Rand punched cards. A total of 116,814 interview cards were returned, from which 109,006 or 93.23% were complete and thereby usable. After the data from these 109,006 cards were transferred to punched cards, the cards were tabulated through an electronic sorter and indices were prepared.

Table I (page 14) depicts the number of dwelling units included in the study. The reader can readily see that 109,006 total units were involved, representing 93.23% of all the dwelling units in Baltimore County. Of this

TABLE I

ANALYSIS OF RETURNS

Total Number of Dwelling Units by Type, by Election Districts, Baltimore County, Maryland 1958

Election District	Type of Dwelling Unit						Totals	
	Cottage (Single Family)	Row House	Apart-ment	Semi-detached	Farm	Trailer	No.	%
1	6,927	2,917	1,510	310	40	4	11,708	10.74
2	4,707	83	338	61	208	15	5,412	4.96
3	5,344	38	70	110	48	1	5,611	5.14
4	2,317	85	274	11	231	2	2,920	2.68
5	392		23	1	291	7	714	.65
6	170		6	5	250	7	438	.40
7	585		84	10	257	8	944	.87
8	3,354	29	140	30	253	72	3,878	3.56
9	11,205	4,925	2,605	609	29	35	19,418	17.80
10	587	23	65	5	315	3	998	.92
11	3,918	43	159	45	389	24	4,578	4.20
12	5,845	8,147	2,236	666	15	118	17,027	15.61
13	4,753	2,118	1,608	69	23	41	8,612	7.90
14	4,846	25	241	727	123	137	6,099	5.60
15	11,362	3,925	3,827	519	151	865	20,649	18.93
Totals No.	66,312	22,368	13,186	3,178	2,623	1,339	109,006	99.96
%	60.83	20.52	12.10	2.91	2.41	1.23	100.00	

Grand Total Dwelling Units = 116,814 100.0%

Total Rejects = 7,808 6.68%

Usable Returns = 109,006 93.32%

number, 66,312 were single family units; 22,368 were row house units; 13,186 were apartment units; 3,178 were semi-detached units; 2,623 were farm units; and 1,339 were trailer units. It can be noted that an additional 7,808 dwelling units were not included in the study because of ambiguous information or lack of identifying criteria.

Interpretation of the Data

Table II is indicative of the way that the data were organized for each of the six types of dwelling units and for each of fifteen election districts (90 actuarial type tables).

TABLE II

Election District 1

Type of Dwelling Unit--Single Dwellings

Assessed Valuation of Dwelling Unit	Number of Bedrooms: 2					3				
	Total Units	Pupil Yield				Total Units	Pupil Yield			
		Pre.	Ele.	Jr.	Sr.		Pre.	Ele.	Jr.	Sr.
Less than $2000	46	.370	.522	.109	.065	36	.194	.694	.306	.028
$2000 - 4999	175	.366	.206	.057	.097	236	.309	.462	.246	.144
$5000 - 7999	535	.331	.357	.084	.082	1097	.406	.497	.180	.127
$8000 - 10999	504	.246	.194	.069	.071	1766	.446	.470	.152	.100
$11000 - 13999	112	.259	.188	.018	.036	700	.349	.437	.181	.157
$14000 - 16999	35	.257	.143	.029	.086	206	.350	.471	.204	.131
$17000 - 19999	16	.188		.063	.063	71	.155	.310	.169	.169
$20000	12	.083	.083			48	.104	.396	.188	.167
	1435	.295	.262	.069	.075	4160	.395	.469	.174	.122
		(.702)					(1.161)			

The data in Table II should be interpreted in the following manner. The decimal or index figures represent the total pupil yield per dwelling unit by level of school, by number of bedrooms, by type of dwelling unit, by election district, and by assessed valuation of the dwelling unit. For example, the reader will note that in Table II there are 535 two-bedroom dwelling units assessed at $5,000 to $7,999. These 535 dwelling units contained a total pupil yield per two bedroom unit of .331 pre-school children, .357 elementary school children, .084 junior high school children, and .082 senior high school children.

The application of these indices is a simple matter. Suppose, for example, that 500 building permits are issued for houses to be built in election district #1. Suppose further that all of these houses will contain two bedrooms and will have an assessed value falling between $5,000 and $7,999. Based on the pupil yield already existing in this area, we could logically expect a total pupil yield of 179 elementary school children (500 x .357), 42 junior high school children (500 x .084), and 41 senior high school children (500 x .082).

In an attempt to bring together, in a relatively small space, as much of the basic data as possible without seriously injuring its individuality, a series of summary tables were constructed depicting the total average pupil yield indices for each type of dwelling unit by election

TABLE III

PUPIL YIELD INDICES BY DISTRICT, BY LEVEL OF SCHOOL,
for Two (2) Bedroom Single Houses

DISTRICT	Number of Units	LEVEL OF SCHOOL				TOTALS (Calculated)
		Pre-School	Elementary	Junior High	Senior High	
1	1435	.295	.262	.069	.075	.702
2	1213	.378	.345	.113	.091	.926
3	994	.393	.296	.078	.045	.813
4	674	.374	.286	.096	.070	.826
5	151	.371	.278	.119	.079	.848
6	77	.429	.377	.079	.013	.896
7	191	.304	.387	.162	.120	.974
8	654	.445	.341	.092	.052	.930
9	2424	.339	.297	.099	.072	.807
10	136	.390	.338	.103	.044	.875
11	1396	.398	.357	.116	.074	.945
12	2768	.348	.398	.133	.084	.964
13	1796	.274	.281	.106	.075	.737
14	1904	.323	.335	.119	.092	.869
15	6023	.412	.477	.154	.090	1.133
TOTALS	21836	.365[1]	.337[1]	.109[1]	.072[1]	

[1]Total Averages

SUMMARY OF ANALYSIS OF VARIANCE DATA

Source	df	S.S.	M.S.	F
Between Levels	3	1,033,995.53	344,665.18	241.91
Between Districts	14	40,049.35	2,860.67	2.007
Error	42	59,839.72	1,424.76	
TOTALS	59	1,133,884.60		

F = 2.54 : .01 evel, 14 and 42 df
1.94 : .05 Level, 14 and 42 df

district, irrespective of lot sizes, assessed values, or rental figures. Table III (page 17) is an example of one of these summary tables. The rationale for these tables is to provide a summary of pupil yield indices for all districts at all levels of school in order that significant trends and differences might become more readily apparent. The reader should clearly understand that the summary tables are not intended to replace the data contained in the ninety basic actuarial type tables.

In further analyzing the data contained in the ninety basic tables, a statistical analysis consisting of a double entry analysis of variance was computed for each summary table. An example of the summary data for the analysis of variance design appears at the bottom of Table III.

Assumptions Underlying Use of Analysis of Variance

Since the analysis of variance method consists of sub-dividing the total variance into parts, each of which can produce independently, the maximum likelihood estimates of variance due to random effects alone, the four underlying assumptions should be examined. First, the variable under consideration must be measured on an interval scale. Since the variable in this study consists in numbers of children and the difference between two and three children is the same as between three and four children, the assumption of the interval scale is fulfilled. Second, the variable must be normally distributed so that the

mean and the variance are independent of each other. The assumption of normality is assumed to be fulfilled in this study. Third, the sample or samples must be randomly selected. Since a complete enumeration of the population was made when gathering the data for this study, the third assumption of randomness does not apply. Fourth, an equality of variance must exist among the several groups of populations (among districts). The fourth assumption of homogeneity of variance was tested by Bartlett's test using Chi-square and was found to be not significant at the .05 level of confidence. Thus, the assumptions are fulfilled.

The statistical levels of confidence (.01 and .05) attached to the summary analysis of variance data in Table III are those which are traditionally employed by researchers. They are simply expressions of probability levels, e.g., significance at the .01 level of confidence indicates that observed differences are likely to occur by chance not more than one time in one hundred replications of the same experiment. At the .05 level of confidence significant differences may be expected to occur by chance not more than five times in one hundred replications of the same experiment.

Limitations

Pupil projection or prediction is affected by the combined influence of a number of variable factors which

are unlikely to operate in the same way in any two given school districts. Persons attempting to apply the indices figures found in this study should proceed with caution. Although the technique would seem to be applicable in school districts other than Baltimore County, there is no assurance that the specific indices figures would be accurate outside Baltimore County. The formula used to derive indices figures were based on stated assumptions of variables identified in Baltimore County. Other school districts using these indices without first recognizing these assumptions and establishing their validity for their school districts are very likely to make pupil yield projections which are grossly in error.

In addition to the geographical limitation stated above, the following limiting factors should be carefully considered:

1. The study is a costly undertaking.
2. The study cannot be completed in a short period of time.
3. Without the use of electronic data processing equipment the replication of such a study would require an extremely large clerical staff to complete the tabulation of data.
4. This study identifies the status of pupil yield for the fall of 1958 and recognizes that the indices are subject to change. These changes could be brought about by a multiplicity of

factors such as changing birth rates, economic conditions existing in the county, the changing racial composition of the pupils, changing mortality rates, extent of acceleration, elimination and retardation in the school system, changes in district boundaries, and the rapidly changing complexion of the rural areas of Baltimore County.

In Review

The flight to the suburbs has assumed the proportions of a wholesale stampede judging from home building in Baltimore County. Home construction is in evidence at all points of the compass beyond the city line. Where once existed wide sweeps of farm land, wooded areas, or grassy fields, today stands row upon row of newly constructed dwelling units. In a recent interview Dr. Ray Hamon, then Chief of the School Housing Section of the Office of Education, said, "The percentage of increase in Baltimore County Public School enrollment since 1920 has far exceeded that for the nation as a whole, and as 1960 approaches this relationship becomes more dramatic..... while the entire nation is now struggling with the problem of providing school housing for an enrollment increase of 49% from 1950 to 1960, Baltimore County is faced with a 126% increase during this ten-year period."

In the County, the school capital improvement program is based upon 75% to 100% utilization of new school buildings upon completion. The alternative would be to open

new schools without potential student bodies at hand, thereby running the risk of creating an expensive facility that conceivably would never be fully utilized. Potential student bodies for planned new schools can only be obtained by temporarily overloading existing school facilities, a process labeled "interim enrollment build-up periods."

To plan a comprehensive school building and to secure the needed sites far in advance, it is imperative that school officials determine those areas within the county which are currently experiencing and are likely to experience the most rapid growth. In Baltimore County the vacant lands surrounding the older, developed urban areas have been subdivided for new residential developments. School authorities would be greatly assisted in projecting enrollments if they could predict accurately the number of children that would likely attend school from these new housing developments prior to the time that the families actually occupy the dwelling units.

The study reported herein purports to present a technique for determining future pupil yield which would be applicable in many metropolitan school districts. The study further attempts to derive specific indices for pupil yield per dwelling unit in Baltimore County. It is believed that this study will enable school authorities to predict pupil yield from new housing developments on the basis of building permits alone before the actual construction of the dwelling units takes place. This in turn

would permit the acquisition of school sites in advance of need to assure the most effective placement of school buildings.

Major Findings

A careful examination of the data reveals several general conclusions which may be stated at this time:

1. Pupil yield per dwelling unit varies by areas of the county.
2. Pupil yield per dwelling unit varies among types of dwelling units.
3. Pupil yield per dwelling unit varies according to the number of bedrooms contained in the dwelling unit.
4. Pupil yield per dwelling unit varies according to the value of the dwelling unit.
5. Pupil yield per dwelling unit varies according to the size of the lot upon which the dwelling unit is located.

Also, a careful examination of the summary tables reveals that for every type of dwelling unit tested there were highly significant differences between the pupil yield for levels of school. Generally speaking, the pupil yield at each level tends to increase directly with an increase in the number of bedrooms. Likewise, the number of older children tends to increase directly with an increase in the number of bedrooms.

Cautions

First, no part of this study is intended to replace intelligent human judgment in predicting future pupil yields. The application of any formula must be tempered with judgment. As reported earlier, the material presented here is expected to yield a reliable tool in an area where few such tools exist. It is believed that the technique employed in this study and its resulting indices, coupled with additional knowledge of dwelling habits in Baltimore County, will constitute a reliable basis upon which sound projections of pupil yield can be made.

In spite of the limitations mentioned earlier in the report, the pupil yield indices identified in this study, when applied with care and viewed with careful judgment, should yield reasonably accurate projections which will enable school officials in Baltimore County to place confidence in the results. All projection techniques to date possess inherent limitations, however, and school officials who recognize this will make provisions for flexibility in individual buildings as well as in the master school building construction program.

Needed Study

There is an urgent need for further study in the area of population projections, particularly in the area of pupil yield and enrollment projections. The need for continued study is accentuated by the fact that projections are transformed rapidly in time of great social and

economic change, whether that change be evolutionary or cataclysmic. Of course, this report is only concerned with those areas bearing a direct relationship to pupil yield projections. On the basis of the findings reported herein there are at least four areas of immediate concern that would warrant the attention and concerted efforts of students in the field. A brief discussion of these four areas follows:

First, the indices reported in this study should be checked regularly and revised through application. This can be done merely by predicting pupil yield for all new housing units in Baltimore County prior to occupancy, comparing the predicted yield to the actual yield and then revising the indices figures in keeping with any consistent discrepancies that are uncovered.

Another fruitful area would seem to be the development of a sampling technique which would yield accurate results.

Yet another application of the data might be found in neighboring school districts and other rapidly growing areas. It would seem profitable to apply the method in other school districts experiencing great growth to determine the applicability of the indices and the applicability of the technique for deriving the indices figures.

Also, the data reported in this study would enable school authorities to develop a master plan for the purpose

of tentatively locating school buildings and acquiring school sites that would be needed with eventual saturation or full utilization of available land. By applying the appropriate pupil yield indices figures to existing zoning regulations it would be possible to determine (in terms of existing pupil yield figures) the minimum and maximum pupil yield in the area. This range would be of considerable value for identifying the number and location of needed school sites and the number, size, and location of needed school buildings. Of course, the value of this type of projection would rest in no small part on the permanency of zoning regulations.

In Conclusion

A well planned school on a site satisfactory to the needs of the children and the adults it is to serve, providing proper educational facilities and uncrowded classrooms is one of the highest assets of any community. Baltimore County, along with many other communities, is confronted with a difficult problem resulting from large scale project developments. The outlying areas are attracting many families. Coupled with this is the application of modern planning principles that has resulted in efficient utilization of the land, thus providing a far greater number of homes per usable square mile. It becomes increasingly important that school facilities be located where they will serve the greatest need. The authors of this document believe that the data reported

in this study will greatly assist school authorities in Baltimore County and will provide a reliable basis upon which sound projections of pupil yield can be made.

APPENDIX

Board of Education of Baltimore County
Towson 4, Maryland

TO: All Elementary School Principals

RE: The 1958 Baltimore County School Census

On the average, it takes $3\frac{1}{4}$ to $4\frac{1}{4}$ years to complete the 40 steps necessary to open a new school. Reliable information is necessary to accurately project plans so far into the future. This information is obtained primarily from the school census and from the analysis of building permits.

During the interval between the biennial censues supplemental information is obtained from the analysis of building permits. In the 1958 Baltimore County School Census several items of information about each dwelling unit in the county will be collected along with the usual enumeration of children. This information about dwelling units is essential for the development of indices to predict school populations for imminent housing developments, indices which will be used in conjunction with the analysis of building permits.

A house-to-house canvass is essential for the successful completion of this two-fold census.

In order to obtain the desired results, it will be necessary to have the cooperation of each elementary school teacher. Your leadership in the past has always inspired such cooperation and a concerted effort is anticipated for the 1958 census.

Very truly yours,

Edward G. Stapleton
Superintendent of Baltimore
County Schools

M E M O R A N D U M

TO: The Elementary School Principals DATE: September, 1958

FROM: The Office of Research and Planning

RE: Clarification of Selected Census Data

1. The State School Law specifically states that a local Board of Education can conduct a bienniel school census. However, Part II of the census card contains information not covered by state law and therefore is voluntary on the part of the occupant. The enumerator is requested to inform the occupant that they are not required to supply the information requested in Part II. However, the information is extremely valuable and necessary for adequate school building planning and the occupant or resident is urged to cooperate in this undertaking. If the resident refuses to supply the needed data, the enumerator is requested to make the necessary estimates. Remember, an intelligent estimate is far more valuable than no information at all and is far more preferable than damaged public relations.

2. IDENTIFICATION CARDS: Several principals have pointed out the desirability of identification cards or letters. A sample authorization (to be supplied by the principal) might read as follows:

1958 BALTIMORE COUNTY SCHOOL CENSUS

_____
(Name)

This is to certify that the above-named enumerator has been authorized to enumerate census data. Your cooperation in supplying the requested information will be greatly appreciated.

_____/S/_____, Principal

_____ Elementary School

3. CALL BACKS: If the resident or occupant of a dwelling unit is not at home at the time of the original visitation, the enumerator is requested to make one return call. If the occupant can not be reached at the time of the second call the enumerator should solicit the needed data from a neighbor (estimating when necessary).

4. A HOUSE DIVIDED: If an enumerator locates a single dwelling unit occupied by the owner but which also contains an apartment, the following procedure should be used:

   a. Complete Part I of a census card for each family.
   b. Complete Part II of a census card for the family occupying the apartment, being sure to check the monthly rental figure.
   c. Complete Part II of a census card for the owner of the dwelling unit, being sure to check the assessed valuation of the entire dwelling unit.

5. STUDENTS AGE 18 OR MORE: Usually, the total number of children recorded in question 5 (Part II) will agree with the number of children listed on the top half (Part I) of the card. There is, however, the following exception: Senior high school pupils (and possibly junior high school pupils) who are 18 years of age or older will not be listed on the top half of the page. However, they should be counted in question 5 on the bottom half of the card.

6. HOUSE TRAILERS: The assessed valuation of a house trailer should be computed by taking 60% of the current market or sale value of the trailer (remember to use the "key" provided). Also, in determining the number of bedrooms contained within a house trailer, a living room or "other" room intended to be converted into a bedroom during the evening hours should be counted as a bedroom.

7. ANONYMITY: The residents name and/or address should not appear on Part II of the census card. It might be helpful to inform each resident that the data will be treated in a confidential manner and the replies, when received in the Office of Research and Planning, will be anonymous.

GOOD LUCK AND BEST WISHES
FOR A SUCCESSFUL CENSUS

DIRECTIONS FOR COMPLETING THE CENSUS CARDS

PART I. Enumeration of Children Through Age 17

1. All entries should be made in ink.

2. The last or family name of a child need be written for a child only when it differs from that of the parent or guardian shown at the top of the card.

3. List the oldest child first and the second oldest next, etc. Give the first name and middle initial of each child in the family under 18 years of age. Do not use nicknames.

4. Date of Birth - For year, write '46, '50, '55, etc. Use numbers to indicate months, i.e., 1 shall stand for January, 2 shall stand for February, etc.

5. Age as of December 31, 1958 - Use the key to find the age in years only.

6. Sex - Check (✓) the correct sex.

7. Public or Non-Public School - Check (✓) the correct column.

8. Grade - Write the number indicating the grade, e.g., 1, 6, 12, etc. Use the following abbreviations:

   Kdg. for kindergarten
   Nurse. for nursery
   Sp. Cl. for special ungraded class

9. Not in School - Check (✓) this column when it applies. If child is of compulsory school age and is not in school, please explain on the reverse side of the top half of the card.

10. Race - Check (✓) W or C in the upper left hand corner; W for white, C for colored.

11. Handicapped children - Each handicapped child should be identified by placing a check (✓) in the appropriate column. It is not necessary to identify the handicap or the degree of handicap and the parent's word will be taken as to whether a child is handicapped or not.

12. Remarks may be made on the reverse side of the appropriate half of the card.

PART II. Information on Dwelling Units

1. Location of dwelling unit by election district - This information will be supplied by the school principal.

2. Location of dwelling unit by census tract - This information will also be supplied by the school principal.

3. Type of dwelling unit - Check (✓) one.

4. Number of bedrooms in dwelling unit - Check (✓) one.

5. Number of children residing in dwelling unit - Insert the number of children for each level. For example, there could be 1 pre-school child, 2 elementary, 1 junior high and 1 senior high school child in one dwelling unit. If you find no children in some (or possibly all) of these groups, leave them blank.

   Prior to detaching and returning the bottom half of the census card to the Office of Research and Planning, check the number of children listed on the top half with item #5. A senior high student who is over 18 would appear in item #5, but would not be listed on the top portion.

6. Assessed valuation - Check (✓) one. When the assessed value of a property (house and ground) cannot be procured from the occupant (some will not want to give the information and others may not know) the following procedure should be utilized:

   a. If there is a similar dwelling in the area for which you have the assessed value, use the same figure; or

   b. Estimate the market or sale value of the property (house and ground) and use the key provided to compute the assessed value.

7. Monthly rental for apartments - Check (✓) one. If the tenant refuses to give the information, do the best job you can of estimating the amount charged for rent.

8. School preparing card - This information will be supplied by the school principal. Before Part II is returned to the Office of Research and Planning, please check to see that the census code number assigned your school has been inserted in item 8.

KEY FOR CALCULATING AGE OF CHILDREN AND ASSESSED VALUATION OF DWELLING UNITS

I.

If date of birth was during the following year	Age of child as of December 31 will be:
1941	17
42	16
43	15
44	14
45	13
46	12
47	11
48	10
49	9
50	8
51	7
52	6
53	5
54	4
55	3
56	2
57	1
58	Under 1

II.

If estimated sale or market value of the dwelling unit (house and ground) is:	The estimated assessed value would be:
Less than $3332	Less than $2000
$ 3,333 - $ 8,332	$ 2,000 - $ 4,999
$ 8,333 - $13,332	$ 5,000 - $ 7,999
$13,333 - $18,332	$ 8,000 - $10,999
$18,333 - $23,332	$11,000 - $13,999
$23,333 - $28,332	$14,000 - $16,999
$28,333 - $33,332	$17,000 - $19,999
$33,333 - $38,332	$20,000 - $22,999
$38,333 or more	$23,000 or more